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PETROLEUM COKE TEST PLAN

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Petroleum HPV Testing Group

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PLAIN LANGUAGE SUMMARY

In petroleum refineries, useful products like gasoline, jet fuel, diesel fuel, motor oils and waxes are separated from crude petroleum, leaving a heavy tar-like residue. More product can be made from this heavy residue by processing it at high temperatures and pressure to crack large molecules into smaller molecules. This process, called coking, leaves behind a hard, coal-like substance called petroleum coke. It consists mostly of carbon with smaller amounts of hydrocarbons (oil) and sulfur, and trace amounts of metals.

This category includes petroleum coke and calcined coke. Petroleum coke, also called green coke, is used primarily as an industrial fuel. Green coke can be further processed at very high temperatures to make calcined coke. This calcining process removes nearly all of the residual oil so that calcined coke consists mostly of pure carbon, with trace amounts of sulfur and metals. The lower oil content makes calcined coke a dustier material than green coke. Calcined coke is used to make synthetic graphite and electrodes for smelting furnaces.

Since coke is made up largely of carbon, and carbon is an inert substance, the potential for coke to cause acute toxicity (harm from exposure to large quantities) is very low. For that reason, health studies conducted by the petroleum industry have looked for possible chronic toxicity, or harm from repeated exposures to the dust over a long period of time. Most of these studies used green coke because of its higher oil content; calcined coke would be expected to have a lower hazard since it is almost entirely carbon.

Exposure to high concentrations of any inert dust can, over time, cause mild to moderate inflammation of the lung, and this was confirmed in laboratory animal studies using high concentrations of green coke dust. These studies, done in rats and monkeys, lasted for two years and showed inflammatory changes in the lungs and nose from the build-up of dust particles. Slight scarring of the lung tissue was seen in rats, but not monkeys. Another important finding was that repeated daily exposures did not cause cancer or other harmful effects on any of the body's organ systems. These studies used concentrations of green coke that were six times higher than the safe level set by OSHA for workplace exposures.

Studies in mice in which green coke dust was applied three times per week to the skin for two years did not produce skin cancer or other effects on the skin. Green coke was also tested for its ability to alter DNA (cause mutations) in a variety of cell culture and animal studies, and those studies were negative. The only endpoints which have not been studied are reproductive effects, and effects on the developing fetus. Those studies will be initiated this year using green coke.

Because petroleum coke is a solid, fairly inert material there has not been much concern about its environmental effects. The typical battery of tests used to measure a chemical's impact on the environment, such as breakdown by sunlight, stability in water, breakdown in the soil and volatility, can not be measured for petroleum coke. In addition, the lack of significant adverse effects in animal studies suggests that the residual oil associated with petroleum coke either does not come off, or is present at amounts too low to cause harmful effects. To evaluate environment effects, samples of green coke will be tested in aquatic organisms, plants and earthworms.

In summary, health studies done on green coke have confirmed its low toxicity. It is reasonable to assume that these findings also apply to calcined coke because it is almost pure carbon. Testing for reproductive effects and possible harm to the fetus are planned for green coke. Green coke will also be studied for possible harmful effects in aquatic organisms, plants and earthworms.

DESCRIPTION OF PETROLEUM COKE

Petroleum coke is a black solid produced through the thermal decomposition of heavy petroleum process streams and residues. The feedstocks undergo cracking and carbonization to a product with a high carbon to hydrogen ratio, which may be granular or needle-like in appearance. Petroleum cokes can be categorized generally as either green or calcined coke. The initial product of the coking process, green coke, is used as a solid fuel. Further processing of green coke at higher temperatures and pressures result in calcined coke which is used in the manufacture of electrodes, in smelting applications, for graphite electrode production, or for minor applications such as carbonization of steel.

Coking Processes and Terminology

Green coke can be produced by one of three processes: delayed, fluid or flexicoking.

Delayed process coke is produced by a semi-continuous batch process and accounts for more than 95% of total US coke production (1). Green coke comes from the coke drum in large pieces and is milled to a smaller size before subsequent use as a fuel or as feedstock for calcining. Green coke can contain as much as 15% residual hydrocarbon, which gives it a characteristic hydrocarbon smell.

Fluid coke is produced by a continuous fluidized bed process. Fluid coke typically contains less residual hydrocarbon than delayed process green coke but more than calcined coke, and occurs as spherical grains less than 1 cm in diameter.

Flexicoke is produced by a variant of the fluidized bed process in which most of the coke is converted to a low Btu fuel gas for use in the refinery in which it was produced. Solid flexicoke has a smaller particle size than fluid coke and is dustier due to its lower residual hydrocarbon content.

Calcined coke is produced from delayed process green coke by a process of further heating at temperatures up to 1200^{o}C. The product of calcining removes virtually all of the residual hydrocarbon including PAHs and the result is a dustier material.

Calcined coke is characterized as either anode-grade coke or graphite needle-grade coke depending upon its physical and chemical characteristics with needle-grade coke having a higher purity than anode-grade coke which is used in electric furnaces in aluminum and steel smelting.

Depending on its physical form, coke may also be classified as shot, sponge or needle coke. Shot coke occurs as hard spheres and is produced from high asphaltene precursors. Needle coke appears as silver-gray crystalline needles and is derived from feedstocks with high aromatic hydrocarbon content. Sponge coke is dull black with a macroscopically amorphous appearance but is a mixture of shot and needle coke structures.

Green coke and calcined coke are covered by definitions of petroleum coke in the EINECS system. They are: Petroleum coke, and Coke (petroleum) calcined. The definitions of these categories are listed in Appendix 1.

Analytical Characterization

Petroleum coke is characterized by its chemical composition and physical characteristics. The chemical composition of petroleum coke is dependent upon the composition of the feedstocks that are used in the coking process, which in turn are dependent upon the composition of the crude oil from which they are derived. The metals and sulfur composition of calcined coke is directly dependent upon the composition of the green coke from which it was produced.

The physical characteristics of petroleum coke are important in determining the suitability of a coke sample for a specific use. These are typically the real and bulk densities and, in the case of anode and needle grade coke, the resistivity and coefficient of thermal expansion. Fuel grade coke may also be characterized by its fuel value (btu/lb).

Typical parameters measured to define the chemical composition of petroleum coke are:
Weight % ash, weight % sulfur, weight % residual hydrocarbon, ppm nickel, and ppm vanadium. Residual hydrocarbon includes organic matter ranging from 6-carbon compounds to 7-ring polycyclic aromatic hydrocarbons (PAHs). Because of the lower temperature used in its production, green or fuel-grade coke contains higher levels of residual hydrocarbon than other grades of coke. The calcining process removes essentially all of the residual hydrocarbon (< 0.5 %).

The following table illustrates the difference between fuel grade green coke and coke intended for aluminum anode grade before and after calcining. These two grades (fuel and calcined) are representative of the two extremes of petroleum coke composition.

Table 1[1]

Properties[2]	Fuel-Grade Green	Anode-grade calcined
Sulfur (wt%)	2.5 – 5.5	1.7 – 3.0
Ash (wt%)	0.1 – 0.3	0.1 – 0.3
Nickel (ppm)	N.D.[3]	165 – 350
Vanadium (ppm)	200 – 400	120 – 350
Residual hydrocarbon (wt%)	9 – 12	<0.25
Bulk density (g/cm3)	N.D.	0.80
Real density (g/cm3)	N.D.	2.06

[1] From Lee et al., 1997
[2] The above values are given for illustration and may vary depending upon the feedstock or crude oil of origin
[3] Not determined

The residual hydrocarbon portion of green coke has been shown to contain PAHs. The PAH content roughly parallels the residual hydrocarbon content of the different grades and processing temperatures of coke. Delayed process green coke, with the highest residual hydrocarbon content was reported to contain higher levels of PAHs than fluid process coke (2). There has been no correlation demonstrated between PAH content and animal or genetic toxicity (see health effects data below).

TEST MATERIAL JUSTIFICATION

This category contains petroleum (green) coke and calcined coke. Both are composed primarily of elemental carbon. The principal attribute that distinguishes green coke from calcined coke is the concentration of residual hydrocarbon. The extremes in composition range from green coke, with relatively high residual hydrocarbon content, to calcined coke with less hydrocarbon and higher elemental carbon. Calcined cokes always contain significantly less residual hydrocarbon than green coke and generally less sulfur. The metal content of calcined coke may be higher than in green coke since the loss of residual hydrocarbon increases the relative content of the metals.

Because elemental carbon is known to be biologically inert, and the residual hydrocarbon content is highest in green coke, health and environmental effects testing will be conducted using green coke. If health or environmental impacts are possible, testing green coke will provide the greatest likelihood of detecting these effects. To date, no adverse effects have been reported which can be attributed to the residual hydrocarbon portion of petroleum coke.

EVALUATION OF EXISTING HEALTH EFFECTS DATA AND PROPOSED TESTING

As described above, the petroleum coke category includes green coke and calcined coke. There have been no human studies of the possible health effects of these materials, but there have been epidemiology studies at manufacturing plants where petroleum coke was in use (3). These studies focused on the effects of dust on respiratory function. Employees completed a medical questionnaire and underwent pulmonary function tests and chest X-rays. The medical evaluations demonstrated decrements in pulmonary function typical of any dusty work environment, and related decreases in pulmonary function to the amount of coke dust exposure. Chest X-rays did not show any indication of pneumoconiosis or chronic lung inflammation.

The majority of the animal toxicity studies available for evaluation has been on green coke (either delayed or fluid process) which has a higher residual hydrocarbon content than calcined coke. In one repeat dose study calcined coke was tested for comparison. An evaluation of the existing studies as well as plans for further studies is summarized below. A matrix (Table 2) summarizing this information can be found at the end of the test plan.

<u>Acute Toxicity</u>

There are no acute oral or dermal toxicity studies available on either green or calcined coke. Because petroleum coke materials are comprised largely of elemental carbon, which is biologically inert, they are considered to have a low degree of acute toxicity. Limited support for this comes from workplace experience and the results of oral and dermal LD 50 studies of carbon black, another carbonaceous material containing organic hydrocarbons albeit in much lower concentrations. LD 50 studies of carbon black resulted in values of >15.4 g/kg and > 3 g/kg respectively for the oral and dermal routes (4). Similarly, feeding studies of thermal black, which contained up to 14 % extractable hydrocarbon, noted no grossly observable effects after up to 72 weeks of exposure to 10% test material in the diet (5).

Repeated dose subacute inhalation studies have been conducted to compare lung responses to green and calcined coke. In these studies, rats were exposed by nose-only inhalation for 5 days to either calcined coke (45 mg/m3) or green coke (58 mg/m3) (6). A silicon dioxide exposure group was also used as a benchmark to judge the potential for the coke samples to cause lung fibrosis. Lung response was evaluated by analysis of lung fluids at 7, 28 and 63 days after exposure. Both green and calcined coke caused slight inflammatory responses in the lung, with the response to green coke being slightly higher. There was no indication of a fibrogenic response from exposure to either the green or calcined coke.

Additional support for the low inhalation toxicity of coke is provided by two-year inhalation studies of green coke in rats and primates in which no signs of systemic toxicity were observed (7,8). The whole body nature of the rat exposures would have resulted in oral ingestion of some test material as a result of grooming. A similar lack of systemic toxicity was noted in a two-year dermal bioassay of green coke suspended in mineral oil (9). The lack of effect from chronic exposures supports the position that acute toxicity of green or calcined coke would be low.

Summary: There are no acute oral or dermal toxicity or irritation studies available on petroleum coke, however, workplace experience, studies of similar materials, and chemical composition suggest a low degree of acute toxicity for these materials. Subacute inhalation studies of both green and calcined coke demonstrated a low degree of toxicity. No acute toxicity studies are planned for this category.

<u>Repeat Dose Toxicity</u>

Repeated dose inhalation toxicity studies of green coke (delayed process) have been conducted in both rats and monkeys. Both studies were conducted at concentrations of 10 and 30 mg/m3 of green coke, which had been micronized into fine particles to aid in aerosol generation (7,8). Both species were exposed for two years. Blood chemistry, clinical chemistry, comprehensive eye examinations and thorough gross and microscopic examinations were conducted at 3-month intervals. The only treatment related effect reported was inflammatory changes in the lungs, caused by the accumulation of fine dust particles. The lung inflammation in rats was greater than in monkeys, in some cases leading to a slight scarring of the lung tissue as a result of chronic inflammation. This is considered a typical response of the lung to high concentrations of dust. Eye evaluations conducted in both studies did not reveal any adverse effects from the exposures. Petroleum coke was <u>not</u> found to be carcinogenic by the inhalation route in either the rat or monkey study.

Repeated dose dermal toxicity studies have been conducted on green coke (both delayed and fluid process). Each of the petroleum coke samples was micronized and suspended in mineral oil, and applied to mouse skin three times per week for two years (9). The only effect observed in the mice was a thickening of the skin in the area of treatment. Neither coke sample caused skin cancer in this study.

Summary: The repeated dose inhalation and dermal toxicity studies indicating low toxicity for green coke are judged adequate for assessing the hazard from inhalation and dermal exposure to petroleum coke. No further testing is planned.

In Vitro Genetic Toxicity

Green coke (both delayed and fluid process) have been evaluated for bacterial mutagenicity in the Ames test using Salmonella typhimurium strains TA 1535, 1537, 1538, 98 and 100, with and without metabolic activation (10,11). None of the coke samples produced a positive response in any of the tester strains.

The delayed and fluid process coke samples were also evaluated in a mammalian cell mutagenicity test using the L5178Y mouse lymphoma cell line (10,11). The tests were conducted with and without metabolizing enzymes in the assay system. Neither coke sample was mutagenic.

Summary: In vitro genetic toxicity testing of green coke has been conducted in both bacterial and mammalian cells with no indication of genetic toxicity. Since green coke has a higher residual hydrocarbon content, these studies are considered adequate to assess the potential for genetic toxicity of calcined coke. No further in vitro mutagenicity testing is planned for this category.

In Vivo Genetic Toxicity

Green coke (both delayed and fluid process) has been evaluated for its ability to produce chromosome aberrations in a bone marrow cytogenetic assay (10,11). Rats were exposed via inhalation to concentrations of 10 and 40 mg/m3 coke dust, and at the end of the study the bone marrow analyzed for chromosomal changes. No changes were seen in animals exposed to the fluid process coke for 20 days. In animals exposed to the delayed process coke for 5 days, an increase in the number of chromosome abnormalities was seen at the high dose only. The laboratory later determined that the slides had been misread, and that the results for the delayed process coke should be considered inconclusive.

Because of uncertainty about the reported positive results in the delayed process coke study, additional bone marrow samples were obtained from animals used in the two-year study described above under "repeated dose toxicity" (7). Analysis was conducted on animals after exposure for 5 days, 12 months and 22 months to concentrations of 10 and 30 mg/m3 coke dust. No abnormal chromosome changes were seen in any of those animals.

Summary: The potential for green coke to cause chromosome abnormalities has been evaluated in two separate inhalation studies with no indication of genetic toxicity. Since the residual hydrocarbon content of green coke is higher than that of calcined coke, it is considered unlikely that calcined coke would cause genetic toxicity in similarly conducted studies. No further testing is planned.

Reproductive And Developmental Toxicity

No studies have been conducted on green or calcined coke to determine the potential for causing adverse reproductive effects or adverse effects on the developing fetus. Repeated dose studies conducted on green coke (described above) did not identify any harmful effects on the reproductive organs.

Summary: Because green coke has a higher residual hydrocarbon content, it will be used in a reproductive and developmental toxicity screening test, conducted by inhalation (OECD 421).

EVALUATION OF EXISTING PHYSICOCHEMICAL AND ENVIRONMENTAL FATE DATA

The physicochemical endpoints in the HPV chemicals program include:

- Melting Point
- Boiling Point
- Vapor Pressure
- Octanol/water Partition Coefficient
- Water Solubility

The environmental fate and effects endpoints include:

- Photodegradation
- Stability in Water (Hydrolysis)
- Transport and Distribution (Fugacity)
- Biodegradation
- Acute Toxicity to Fish
- Acute Toxicity to Aquatic Invertebrates
- Toxicity to Algae (Growth Inhibition)

Developing meaningful physicochemical and environmental fate and effects information/data for materials in the Petroleum Coke category will not be possible for certain endpoints because of their chemical structure and physical nature. Materials in this category are amorphous solids, composed primarily of carbon and are either not amenable to standard testing guidelines or the endpoints of interest are not relevant in view of their chemical structure. Petroleum Coke is also not subject to structure based modeling because it does not have a single, unique chemical structure.

Both green and calcined cokes are relatively inert and would not be expected to interact with the environment in an adverse manner. This is perhaps why little environmental information has been developed for these materials. However, with the exception of the aquatic toxicity endpoints, relevant environmental information will be summarized in technical discussions for the endpoints listed above. Limited aquatic toxicity testing will be conducted to assess the potential toxicity of these materials.

Petroleum Coke is used as a soil amendment to improve the insulative capacity of soils beneath power stations. The fate and effects endpoints in the HPV chemicals program do not include soil toxicity tests. Nevertheless, this testing plan will include selected terrestrial toxicity studies to develop data for this purpose.

Physicochemical Data

Physicochemical data for the Petroleum Coke category that can be used in the HPV chemicals program were not found. There are estimation structure-activity relationships for the physicochemical endpoints in the computer program EPIWIN (12) (Estimation Program Interface for Windows) and EPA has suggested that subroutines in this program would be acceptable to develop data for these endpoints (13). However, this program functions using specific structure based rules that cannot be applied to structures representative of the Petroleum Coke category. There is more information on the use of EPIWIN for the HPV chemical program in the EPA document titled, *The Use of Structure-Activity Relationships (SAR) in the High Production Volume Chemicals Challenge Program*.

Developing measured data for a material representative of the Petroleum Coke category is limited by the fact that these materials are solids and water insoluble under relevant environmental conditions. As an alternative to not being able to model or develop measured data, technical discussions will be developed that characterize selected physicochemical properties of materials in the Petroleum Coke category.

Summary: Testing and computer modeling of physicochemical endpoints will not be conducted for materials in the Petroleum Coke category because their structure precludes developing data in either of these manners. Instead, technical discussions on each property will be prepared and added to IUCLID, which is the electronic database that will contain data for the HPV chemicals program.

Environmental Fate Data

Environmental fate data for the Petroleum Coke category that can be used in the HPV chemicals program were not found. The following describes the fate endpoints and the type of information that will be developed.

Photodegradation: Direct photochemical degradation occurs through the absorbance of solar radiation by a chemical substance. If the absorbed energy is high enough the resultant excited state of the chemical may undergo a transformation.

Photodegradation can be measured (14) (EPA identifies OECD test guideline 113 as a test method) or estimated (13). An estimation method accepted by the EPA includes the calculation of atmospheric oxidation potential (AOP). However, only chemicals that have a potential to enter a vapor phase will be available for atmospheric oxidation reactions with photochemical generated hydroxyl radicals. Because Petroleum Coke is a solid for which a representative molecule that would be amenable to modeling does not exist, the accepted procedures used to assess photodegradation are not appropriate. Therefore, to satisfy the HPV chemicals program for this endpoint, a technical discussion will be developed for this endpoint.

Summary: Photodegradation testing and computer modeling will not be conducted for materials in the Petroleum Coke category because they are not subject to this fate process. Instead, a technical discussion on the potential for these materials to photodegrade will be prepared and added to IUCLID, which is the electronic database that will contain data for the HPV chemicals program.

Stability in Water: Hydrolysis of an organic chemical is the transformation process in which a water molecule or hydroxide ion reacts to form a new carbon-oxygen bond. Chemicals that have a potential to hydrolyze include alkyl halides, amides, carbamates, carboxylic acid esters and lactones, epoxides, phosphate esters, and sulfonic acid esters (15).

Stability in water can be measured (16) (EPA identifies OECD test guideline 111 as a test method) or estimated (13). An estimation method accepted by the EPA can calculate hydrolysis rate constants for esters, carbamates, epoxides, halomethanes, and selected alkylhalides. Materials in the Petroleum Coke category are not subject to hydrolysis.

To fulfill this endpoint, a technical discussion as to why these materials are not subject to hydrolysis will be developed. The discussion will include a description of the general chemical structure for materials in this category.

Summary: Hydrolysis testing and computer modeling will not be conducted for materials in the Petroleum Coke category because they do not undergo hydrolysis. Instead, a technical discussion on the potential for these materials to hydrolyze will be prepared and added to IUCLID, which is the electronic database that will contain data for the HPV chemicals program.

Chemical Transport and Distribution in the Environment (Fugacity Modeling): Fugacity based multimedia modeling can provide basic information on the relative distribution of chemicals between selected environmental compartments (i.e., air, soil, sediment, suspended solids, water, and biota). The US EPA has agreed that computer modeling techniques are an appropriate approach to estimating chemical partitioning (fugacity is a calculated endpoint and is not measured). A widely used fugacity model is the EQC (Equilibrium Criterion) model (17). EPA cites the use of this model in its document titled *Determining the Adequacy of Existing Data* (18), which was prepared as guidance for the HPV chemicals program.

Because materials in this category are solids whose structure would not be amenable to modeling, a brief technical discussion as to where they would partition in the environment will be developed. The discussion will include a general description of the composition and chemical structure for these materials.

Summary: Fugacity based computer modeling will not be conducted for materials in the Petroleum Coke category because their structure precludes them from being modeled. Instead, a technical discussion on the potential environmental distribution of these materials will be prepared and added to IUCLID, which is the electronic database that will contain data for the HPV chemicals program.

Biodegradation: Biodegradation is the utilization of a chemical by microorganisms as a source of energy and/or carbon. The parent chemical is broken down to simpler, smaller chemicals, which are ultimately converted to an inorganic form such as carbon dioxide, nitrate, sulfate, and water. Assessing the biodegradability of chemicals using a standard testing guideline can provide useful information for evaluating chemical hazard.

Biodegradation can be measured using the OECD test guidelines 301A-F or 302A-C (18). However, because of their structure and physical state, materials in the Petroleum Coke category would not be subject to biodegradative processes that would be measurable with standard testing guidelines. Therefore, a technical discussion will be developed on the potential of these materials to biodegrade.

Summary: Biodegradation testing will not be conducted for materials in the Petroleum Coke category because they do not biodegrade. Instead, a technical discussion on the potential of these materials to degrade will be prepared and added to IUCLID, which is the electronic database that will contain data for the HPV chemicals program.

EVALUATION OF EXISTING ECOTOXICITY DATA AND PROPOSED TESTING

Aquatic Toxicity

There are no data that can be used to evaluate the toxicity of Petroleum Coke to aquatic species. There are three aquatic toxicity endpoints in the HPV chemical program. EPA identifies the following test methods to determine these endpoints: OECD Guideline 203, *Fish Acute Toxicity Test*; Guideline 202, *Daphnia sp., Acute Immobilization Test*; and Guideline 201, *Alga Growth Inhibition Test* (18,19).

The purpose of these aquatic toxicity tests is to determine the concentration or loading of a test material in a test medium that will produce mortality or inhibition to 50% of a population of organisms. Depending on the physicochemical characteristics of the material, it is possible that acute effects may not occur (i.e., a test material may have no to very low water solubility and as a result may not achieve a concentration or loading sufficient to cause effects).

Materials in the Petroleum Coke category are not expected to exhibit measurable water solubility. Therefore, acute aquatic toxicity is not expected. Nevertheless, two of the three aquatic toxicity tests will be conducted to confirm these expectations. Green Coke will be tested using a daphnid and alga species, because it has a higher residual hydrocarbon content. The aquatic invertebrate is generally considered more sensitive to chemical toxicity than fish. If no effects are demonstrated in *Daphnia*, the results will be used as evidence that these materials would not be expected to produce acute effects in fish.

Summary: There are no existing data evaluating aquatic toxicity of petroleum coke. Green Coke will be tested in *Daphnia* immobilization and alga inhibition tests.

Terrestrial Toxicity
Materials in the Petroleum Coke category are sometimes used in a manner that can expose selected terrestrial species to their residues. However, there are no data that can be used to evaluate the potential for toxicity of these materials to terrestrial species. Since these materials can be incorporated in surface soil, their toxicity will be evaluated using test methods described in the OECD Guidelines 207, Earthworm, Acute Toxicity Test, and 208, Terrestrial Plants, Growth Test.

Summary: There are no existing data evaluating the effects of petroleum coke on terrestrial soil species. Green Coke will be tested in earthworm and plant toxicity tests.

Table 2

Matrix of Available Adequate Data and Proposed Testing on Petroleum Coke		
Test	Petroleum Coke (Green) CAS # 64741-79-3	Petroleum Coke (Calcined) CAS # 64743-05-1
Partition Coefficient	N/A	N/A
Water Solubility	N/A	N/A
Biodegradation	N/A	N/A
Environ. Transport	N/A	N/A
Acute Fish	NT	NT
Acute Daphnia	Test	C
Algae	Test	C
Terrestrial	Test	C
Acute Oral	N/A	N/A
Acute Inhalation	NT	NT
Acute Dermal	N/A	N/A
Repeated Dose	Adequate	Adequate
Genotoxicity, in vitro, bacterial	Adequate	C
Genotoxicity, in vitro, non-bacterial	Adequate	C
Genotoxicity, in vivo	Adequate	C
Repro/Developmental	Test	C

Adequate Indicates adequate existing data.

Test Indicates proposed testing

C Indicates category read-across from existing or proposed test data.

N/A Indicates that evaluation of endpoint Not Applicable due to physical-chemical state or route of administration. Technical discussions will be developed to address these endpoints as appropriate.

NT No Testing proposed for reasons provided in test plan.

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APPENDIX 1

Petroleum Coke Category Constituents by CAS

CAS No.	EINECS No.
64741-79-3	265-080-3

Coke (petroleum)

A solid material resulting from high temperature treatment of petroleum fractions. It consists of carbonaceous material and contains some hydrocarbons having a high carbon-to-hydrogen ratio.

CAS No.	EINECS No.
64743-05-1	265-210-9

Coke (petroleum), calcined

A complex combination of carbonaceous material including extremely high molecular weight hydrocarbons obtained as a solid material from the calcining of petroleum coke at temperatures in excess of 1,000^{o}C (1800^{o}F). The hydrocarbons present in calcined coke have a very high carbon-to-hydrogen ratio.